So we continue our journey by briefly studying the Immune System. Your immune system is an amazing army of cells and chemicals that work 24/7 to protect you from all manners of harm including radiation, chemicals and parasites (bacteria, viruses, microbes, protozoa, etc.).

We are briefly going to go over how the Immune System works because our clients are compromising their immune systems while they are using drugs of addiction.

The 4 drugs found to have a negative influence on the immune system are: alcohol, marijuana, methamphetamine and inhalants. These four drugs depress the immune system’s ability to recognize and fight foreign invaders or unhealthy internal conditions.

It is possible to go for quite a long period of time without realizing that your immune system is not working well. For instance, a person can go for several years without realizing that their immune system is being attacked by the Human Immunodeficiency Virus (HIV). This is true of Hepatitis C also – a person can live for several decades without realizing that their liver isn’t doing so well.
The body is an intricate balance of numerous systems working together, all with the goal of achieving homeostasis – the balance where a person is feeling “normal.”

The lymphatic system (lymph, also known as interstitial fluid, is squeezed by muscle contractions into all parts of the body) and the red blood system are primarily the two systems that are responsible for coordinating an immune response against a foreign invader or environmental concern.

It is important after a surgery for the medical team to get the patient up and walking as soon as possible in order to help engage the immune/lymph system.

You can imagine for a client new in recovery how hard it is to be motivated to move and exercise but those are some of the best ways to help engage the immune system along with the other systems.
The immune system is crucial to human survival. In the absence of a working immune system, even minor infections can take hold and prove fatal. Without intensive treatment, children born without a functional immune system die in early childhood from the effects of common infections. However, in spite of their immune systems, all humans suffer from infectious diseases, especially when young. This is because the immune system takes time to build up its strongest response to an invading microorganism, time during which the invader can multiply and cause disease.

To provide immunity that will provide protection from the disease in the future, the immune system must first do battle with the microorganism. This places people at highest risk during their first infection with a microorganism and, in the absence of modern medicine, leads to substantial child mortality, as witnessed in the developing world. When entire populations face a completely new infection, the outcome can be catastrophic, as experienced by indigenous Americans who were killed in large numbers by European diseases to which they were suddenly exposed after 1492. Today, infection with human immunodeficiency virus (HIV) and the acquired immune deficiency syndrome (AIDS) it causes are having a similarly tragic impact on the populations of several African countries.

Source:  http://www.garlandscience.com/textbooks/0815341466/pdf/ch01.pdf
Our bodies have barriers and defenses that work to keep pathogens (foreign substances) from gaining entry in the body.

Skin, tears, saliva, gastric acids, mucous secretions, digestive and intestinal enzymes and bacteria all work to discover, recognize and eliminate or prevent action by pathogens and other substances.

Systems that our body uses to fight infectious diseases include:

- **Tears**: each blink spreads an antibacterial eyewash containing the enzyme lysozyme
- **Mouth & Throat**: salivary glands and saliva
- **Respiratory Tract**: nostril hairs, mucus, cilia in the lining of the nose and trachea – keep items larger than 5 microns out
- **Stomach**: hydrochloric acid and other digestive enzymes
- **Small Intestine**: strong digestive acids and enzymes
- **Pancreatic Juices and Bile Salts**
- **Large Intestine**: your gut flora (your friendly bacteria)
- **Genitourinary Tract**: mucous lining and friendly bacteria
- **Your Skin**: a mechanical barrier and your 1st line of defense
The human body is primarily protected by its skin and its lymph and immune systems. Intact skin is a major form of defense.

Every moment of every day, the body is open to two types of hostile events:

- **external concerns**: physical harm & lingering germs
- **Internal concerns**: the body’s own cells, which can set up diseases via mutations, resulting in cancers

The chief troops of the immune systems are roving white blood cells. There is a network of white blood and other immune cells in the blood vessels, lymphatic fluids, lymph nodes and glands.

**ACTIVITY:** Please paste the following link into your web browser and open up the following document as it will help you to have a good general overview of the immune system, and is an important resource for you:

Our immune system is made up of many different structures with the common objective of protecting our bodies from foreign pathogens and other invaders. As you can see there are many organs involved in the immune system.

*Remember when we would get ice cream for getting out our tonsils or when a doctor would assert that the appendix was an unnecessary organ?*

The primary cell of our immune system is the white blood cell, also known as a leucocyte.

There are two kinds of white blood cells/leucocytes: phagocytes and lymphocytes.
This slide gives you a general idea of the many different cells that are members of the immune system.

Phagocytes (also known as macrophages) are similar to little Pac-men that cruise around chewing up and destroying invading organisms.

Lymphocytes learn, remember, recognize and eliminate current and previous invaders (your antibody system). The two main types of lymphocytes are the B- and T- lymphocytes. All lymphocytes originate from stem cells in the bone marrow.

Antibodies, which are created by the B-lymphocyte system, neutralize poisonous toxins and other damaging substances. Viral and bacterial exposure and infection engage the immune system and if the body is able to fight off the infection on its own, an antibody memory of the infection is created for future exposure.

Many times the body fights its own invaders; other times antibiotics and anti-retroviral medications are necessary to deal with the infection and disease.
- All cells that belong to the host person have a unique identifying marker on the outside of the cell, that indicate to the immune system that they are part of the host and are not to be destroyed.

- Cells that do not have the unique identifying marker of the host will be detected and destroyed by the immune system.

- The immune system has the complex job of differentiating between cells and substances that belong to the host and those that do not.

- Several drugs compromise the immune system’s ability to protect the host. They are alcohol, marijuana, methamphetamine and inhalants.
  
  However, all drugs of addiction with continued use will impair the person’s overall health and ability to fight off infections. These four drugs in specific slow down the immune system’s activities, allowing unwanted pathogens an opportunity to enter the host person and begin an infection.
- We take in foreign substances every time we breathe or put something in our mouth. The nasal and oral cavities as well as the stomach are home to many immune system cells waiting to attack a foreign invader.
These are examples of several different cells that we have in our body.

A cancer cell is not actually a pathogen or microbe or even considered an “infection.” A cancer cell is a normal cell within the person that has mutated and the mutation is growing on its own.

Mast cells manufacture histamines. Histamines trigger an inflammatory responses. In the immune system, histamines increase the permeability of the blood capillaries of the cardiovascular system so white blood cells and other immune system proteins can get to the infected tissues. Mast cells tend to be in greater concentrations in those areas of the body prone to injury (i.e., nose, mouth, feet, hands). *A great example of the histamine system in action is allergies – think runny nose!*

Stem cells: All cells in the human body are created and given their specialized tasks by stem cells in the bone marrow. For the fetus, stem cells differentiate into all of the cells that create the fetus. In adults, stem cells repair or prevent system damage by creating the cells that replace those undergoing normal or sudden turnover.
This is a picture of a B-lymphocyte.

Facts about B-lymphocytes:

- Lymphocytes that remain in the bone marrow are called B-lymphocytes or B cells.

- B-lymphocytes are the body's intelligence surveillance team: they seek out pathogens and other targets, and then send defenses to lock onto them and eliminate them.

- B-lymphocytes recognize the antigens (proteins on foreign substances) on the pathogen. It is these antigens that antibodies and the immune system cells lock onto.

- B-lymphocytes produce antibodies, which are specialized proteins that lock onto and disable specific antigens/pathogens. Each antibody is specific to one specific antigen/pathogen. Your immune system library develops billions of antibody memories over a lifetime.
This is a picture of a T-lymphocyte.

Facts about T-lymphocytes:

- T-lymphocytes begin in the bone marrow and then migrate to the thymus gland where they mature into T cells.

- T cells are the destroyers. They destroy many invaders, including viruses.

- Once the B cells initiate an alert system, the T cells are capable of destroying the tagged antigens (tagged by the B cells).

- The T-cells (also known as T-lymphocytes) are the cell that is targeted by the HIV virus. The HIV virus is able to enter into this T cell and produce multiple copies of itself before destroying the T-cell. The HIV virus is able to turn off the T-cell alert system that notifies the body it is in trouble.
Picture of a Normal T-lymphocyte

- T lymphocytes are also known as T cells because the thymus is where T cells mature. T cells are white blood cells in the lymphocytes family. There are several different types of T cells.

- Helper T cells provide support to the two other major immune system cells: the B-lymphocytes and the macrophages. Helper T cells have CD4 proteins/receptor sites on their surface, which is the T cell that HIV attacks exclusively.

- Cytotoxic T cells are known to destroy virally infected cells and tumor cells. They are involved in transplant rejection.

- Memory T cells are where the memories of past infections are stored after an infection has been resolved.

- Regulatory or suppressor T cells are activated towards the end of an immune system response to stop the immune system engagement.

- Natural killer T cells are able to perform the functions of both Helper T cells and Cytotoxic T cells as needed. These natural killer T cells have also been able to recognize and eliminate some tumor cells and cells infected with the herpes virus.
Blood plasma is the yellow liquid found in our blood. Plasma accounts for about 55% of the total blood volume and is approximately 90-92% water. Drugs and drug fillers (Splenda, baby laxative, baby’s milk, etc.) that are water soluble dissolve easily into the plasma portion of our blood.

The red blood cells transport many substances throughout the body, including nutrients and oxygen. The pumping action of the heart transports blood/plasma fluid to all parts of the body.

Blood is vital for our existence for several reasons:
- to supply oxygen and nutrients to the body
- remove wastes and toxins and dead cells
- to help with the circulation of white blood cells and antibodies
- to create clots at the sites of open wounds in order to close the wound itself
- to transport hormones
- to regulate pH and establish overall homeostasis
- to regulate core body temperature
The pictures above illustrate the numbers and complexity of cells found in our blood, that are transported throughout the body by the circulatory system.

Red blood cells are concave in the center in order to hold onto gases more easily. Gases can include oxygen, carbon dioxide, and smoke from cigarettes, marijuana joints, crack cocaine, crystal meth, etc.

Platelets, which are an essential ingredient of our blood, assist with the distribution of hormones and with cell clotting.

In the picture on the right, the platelet is the middle cell. The bottom cell is a hemoglobin red blood cell, and the top cell is an immune system lymphocyte.
This is a picture of a macrophages, which are like Pac-men. They are the white blood cells known to “eat” by engulfing and digesting debris, pathogens, microbes and other foreign substances. This process of “eating” is called phagocytosis.

Macrophages have the important job of removing debris from within the lungs, including dead cell material and other cellular debris.

Macrophages can digest approximately 100 bacteria before they “die.”

Macrophages as the “scavengers” of the immune system. They generally are roving about the human body or they receive a signal to address a specific problem.

There are several places where macrophages have ongoing assignments: the lungs, connective tissues, liver, neural tissue, bone and spleen.

Some foreign substances are quite waxy and hard to latch on to. Can you see how this would wrap itself around many substances well!
An immunoglobulin or antibody is a specialized protein of the immune system. Antibodies are made by plasma cells, which are a specialized white blood cell. When antigens/foreign substances/pathogens are detected by the roving lookout cells – B lymphocytes are triggered to produce antibodies which act as specialized proteins that lock onto the pathogen to destroy it. The V part of the Y is unique to each pathogen.

Antibodies destroy the specific pathogen with the help of the T lymphocytes. Antibodies are created with a very specialized Y region – each antibody attaches to a specific antigen or pathogen much like a key that only fits a specific lock and is unable to open other locks.

There are five main classes of antibodies: IgA, IgD, IgE, IgG and IgM.
- IgA: 2 types: found in mucous membranes (gut, respiratory tract, urogenital tract), saliva, tears, breast milk
- IgD: 1 type: on B cells: activates basophils and mast cells for antimicrobial factors
- IgE: 1 type: attaches to allergens, triggers histamines from mast cells & basophils, involved in allergic reactions & protects against parasitic worms
- IgG: 4 types: provides the majority of the defense against pathogens – does cross placenta to provide passive immunity protection to fetus
- IgM: 1 type: on surface of B cells, eliminates pathogens and offers protection until other immune system cells arrive
• The defense against infections is carefully orchestrated, using intricate inter-relationships of physical, cellular & chemical activities.

• An infection occurs when microscopic parasites gain entry into the body, survive, multiply and disrupt normal cell function. The infection may be localized to one area or systemic, in which the organisms are carried around the body by the blood.

• Most microbes and pathogens can trigger an antibody response.

• Organ transplants have been known to trigger an rejection/antibody response. In this event, the organ has someone else’s markers on it and the immune system recognizes the organ as foreign and attempts to attack it. A person who has received an organ transplant is given anti-rejection drugs, which work by suppressing the immune system so it will stop attacking the organ.
  - Use of steroid medications are also known to suppress the immune system.
A large library of antibodies exists in every person. It is estimated that your library contains as many as 10 billion different antibodies, each designed for very specific antigens/pathogens.

Immunizations/vaccinations assist us with specific pathogens by giving the person either a dead or inactivated pathogen. The dead or inactivated pathogen triggers the immune system to create antibodies that can then be added to the library of antibodies.

A question for all treatment providers: Does your doctor know what you do for a living? As health care specialists you are working with a high risk population. Questions have surfaced regarding how long antibodies remain in the library. If one has not been exposed to a specific antigen for many decades – is it possible that the antibody no longer exists?
The lymphatic system is a series of conduits that disperse lymph, a clear fluid, throughout the body. Lymph moves every time a muscle is contracted. The active part of lymph system is the lymph fluid, which starts life as interstitial fluid that collects between cells throughout the body.

This fluid drains into networks of tiny capillaries in tissue spaces, that then come together to form larger vessels called lymph vessels.

Lymph nodes (glands) are the filtering and storage areas of the system. They are scattered along the routes of the lymph vessels. Lymph nodes are very small (less than 1”x1”x1”) and have pockets inside, much like a pomegranate. Lymph nodes or “glands” are vital in that they produce and house the lymphocytes that protect the body from disease.

The slowly circulating lymph fluid helps distribute nutrients throughout the body, and collects wastes.

When a lymph node is swollen, the body is fighting an infection within its compartments.
There are 3 main categories of harmful microorganisms:

- Parasites
- Viruses (extremely small parasites)
- Bacteria (larger than viruses – respond to antibiotics)

- Parasites are any organism that requires a host in order to live. Parasites include viruses, crabs, lice, and scabies.

- **Viruses are extremely small and require a host agent in order to reproduce itself. Viruses cannot exist independently of a host, except as an inactive chemical structure. Viruses must gain entrance into a cell in order to replicate itself – using the host cell as its photocopy machine arena to make lots of copies of itself. Viruses are small enough to gain entry into most cells and most tissue, including the brain.**

- Bacteria have cellular machinery for obtaining energy, processing nutrients and reproducing themselves. Bacteria are much larger than viruses and usually reside on the outside of cells.
- top left: ecoli
- top right: giardia – can see why it does well in water!
- middle and bottom two: influenza

There are thousands of different types of viruses with shapes including balls, boxes, polygons, sausages, golf balls, spirals and even tiny space rockets.

Viruses are classified by their size, shape and symmetry as well as by the groups of disease they cause.

These computer drawings of the influenza virus show how complex a virus’s outer coat is in order to protect its genetic material. Anti-viral medications have to penetrate or damage the coat in order to kill the virus. The body’s natural immune system is able to kill many viruses on its own. Most viruses do not have a medication to eradicate them. Viruses mutate and change their genetic material as well as their outside coat rapidly and continuously, in response to the environment. They are intelligent!! Viruses are approximately 1/16,000th the size of a bacteria. They are microscopically tiny!!!
- **top left**: green piles virus
- **top right**: retrovirus: leukemia
- **bottom left and right**: West Nile virus
The Life Cycle of a Virus:

- A free virus particle enters the body and looks for the cell it prefers to invade. Most viruses are specific to certain cells.
- The virus finds the entrance into the host cell and inserts itself within the targeted cell.
- The virus takes its genetic/nucleic acid strands and inserts it into the host DNA, or the virus is able to create copies of itself without inserting itself in the host DNA.
- The virus begins nucleic acid replication of its viral genetic material, making lots of photocopies of itself, using materials and energy from within the host cell. It can make one or a few or many copies of itself.
- The newly created budding virus is now ready to go find other cells to invade.
- The buds are release from the host cell, which usually kills the host cell in the process.
- **Immuno-deficient OR Immuno-compromised:** the immune system has been compromised (i.e., by drugs such as alcohol, meth, marijuana, inhalants) or is entirely absent. Most immune system deficiencies are acquired, but people have been born with no immune system or only partial amounts of an immune system. *Have you ever know someone who seems to always be sick or picks up everything going around?*

- **Immuno-suppressed:** the immune system is suppressed:
  - this can be deliberately induced by using immunosuppressant drugs to prevent rejection of an organ transplant or bone marrow transplant or for treatment of autoimmune disorders like Rheumatoid arthritis and Crohn’s disease
  - this can be the result of radiation and/or chemotherapy
  - cortisone and other steroid treatments are known to suppress or depress the immune system
  - some pathogens have been known to suppress the immune system

- **Opportunistic infections:** infections that result when a pathogen is able to gain entrance into a host person while their immune system is in a compromised or deficient state due to another condition
  - example: HIV infection can leave the body more susceptible to opportunistic infections like Tuberculosis, herpes, hepatitis
Immunization = vaccination

When an individual receives a vaccination, they are receiving either dead, weakened, or inactivated pathogens, microbes or toxins in order to stimulate an immune response, without making the person sick.

The activated immune response, produced by a vaccination, allows the immune system to create the necessary antibodies for its library for future exposure to the pathogen.

Active immunization occurs every time an individual successfully makes antibodies in response to pathogens or other substances that have entered the body or were delivered via vaccination.
Passive immunization occurs when antibodies are given to the individual, or when the mother’s immune system is protecting the fetus, or when a mother is breastfeeding a newborn.

A person who has been exposed to tetanus but does not have a current active tetanus shot will be given antibodies to fight the bacteria immediately, before it can cause major harm to the body.

If a person has been exposed to Hepatitis A, B or HIV there are antibody vaccinations that have to be administered within 2 weeks of exposure, to keep the virus from gaining a foothold in the person.

If urgent protection is needed, or if a person’s immune system is weak, passive immunization can be used.

Babies receive passive immunization by getting its mother’s antibodies in the breast milk.
The first time an individual is exposed to a pathogen – the immune system needs several days in order to mount an effective immune response.

After the first exposure, the immune system has created an antibody-pathogen memory, which it stores for future exposures.

Subsequent exposures require minutes to hours for the immune system to “remember” the pathogen and can often mount an effective immune response without any awareness by the host.

The learning curve is the longest with the first exposure, whether the exposure is by the actual pathogen/substance or exposure is via vaccination.
• Immune system disorders fall along a continuum from less threatening to life threatening.

• Allergies are a hypersensitivity and overreaction of the immune system. The most common allergies are environmental (hay fever, food allergies, insects, wasps, bees, snake bites). Other allergic reactions include eczema, hives, and asthma attacks.

• Auto-immune disorders occur when the immune system is attacking substances and tissues that are part of the self and have self-markers. In these cases, the immune system is attacking its own cells.

• Examples of auto-immune disorders include: Addison’s Disease, some arthritis’, Coeliac Disease, Diabetes mellitus type 1, Graves’ disease, Lou Gehrig’s disease, Lupus, Multiple Sclerosis, Myasthenia gravis, Narcolepsy, Psoriasis, Rheumatoid arthritis, Sjogren’s syndrome, Ulcerative Colitis, and Vasculitis.
- Hairy golf balls or pollen?

- They look scratchy and itchy don’t they :)